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The determinants of regulatory responses to risks from financial innovation: Survey evidence from G20

By

Ivan Diaz-Rainey
Department of Accountancy and Finance, University of Otago, New Zealand
John K. Ashton
Bangor Business School, Bangor University, UK
Max Yap
Department of Accountancy and Finance, University of Otago, New Zealand
Murat Genc
Department of Economics, University of Otago, New Zealand
&
Rosalind Whiting
Department of Accountancy and Finance, University of Otago, New Zealand

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Bangor Business School
Bangor University
Hen Goleg
College Road
Bangor
Gwynedd LL57 2DG
United Kingdom
Tel: +44 (0) 1248 382277
E-mail: business@bangor.ac.uk

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Abstract:

We explore the factors that shape the extent and scope of the response of G20 countries to a Financial Stability Board (FSB) recommendation aimed at mitigating the risks from financial innovation. Using a formal content analysis of the FSB's *Implementation Monitoring Network Surveys*, we develop an index of disclosed strength of regulatory responses. We find that G20 countries have displayed large interpretive differences, little forward planning and have emphasized regulatory capabilities over firm capabilities when addressing the recommendation. Countries with strong central banks, more concentrated regulatory structures and bank-based financial systems responded more robustly, while countries with a large financial sector were marginally associated with a weaker response. The latter suggests that financial sector lobbying has weakened regulatory responses.

Keywords: Financial innovation, financial regulation, Global Financial Crisis, G20, Financial Stability Board

JEL: G01, G18, G20, G28

1. Introduction

Which factors shape the extent of regulatory responses to contemporary policy concerns? We examine this question in the context of financial innovation: a subject high on the agendas of policymakers, regulators, and academics (e.g., Allen, 2012; Gennaioli et al., 2012; Lerner and Tuffano, 2011; Shiller, 2013; Thakor, 2012) following the central role that financial innovations such as Collateralized Debt Obligations (CDO) and Credit Default Swaps (CDS) may have played in the most severe financial and economic crisis since the Great Depression (Allen, 2012; Brunnermeier, 2009; Mason, 2008). This examination is undertaken through assessment of a key recommendation of the Financial Stability Board (FSB) at the 2009 G20 meeting in London which aimed at mitigating risks from financial innovation. The recommendation stated that:

> "*Supervisors should see that they have the requisite resources and expertise to oversee the risks associated with financial innovation and to ensure that firms they supervise have the capacity to understand and manage the risks*."(Financial Stability Forum [hereafter FSF], 2008, p. 40)

We examine how G20 countries are interpreting and implementing this recommendation and which institutional factors influence their regulatory responses. This is achieved using a content analysis of G20 countries' progress on reforms as reported in the annual *FSB Implementation Monitoring Network Surveys*. Our assessment considers these proposals both descriptively and empirically through an examination of the factors associated with regulatory responses. We find that G20 countries have displayed large interpretive differences, little forward planning and have emphasized regulatory capabilities over firm capabilities when addressing the recommendation. Countries with strong central banks, more concentrated regulatory structures and bank-based financial systems responded more robustly, while countries with a large financial sector were marginally associated with a weaker response. The latter suggests that financial sector lobbying has weakened regulatory responses.

This assessment is timely for a number of reasons. First, the Financial Stability Board (FSB) was established in response to the Global Financial Crisis (GFC), to address vulnerabilities of the financial system and "*to develop and promote the implementation of effective regulatory, supervisory and other financial sector policies*"[1] by the 2009 G20 government meeting in London. This body is charged with monitoring the implementation of a host of G20 recommendations agreed at the G20 summits in London (2009), Pittsburgh (2009), Toronto (2010), Seoul (2010) and Cannes (2011).[2] In light of the global importance of this international regulatory architecture, empirical evidence as to its relative success in driving policy change and the impediments faced by this body are important to determine.

Secondly, the content analysis recognises that the FSB's recommendation on the risks from financial innovation has two components. The first relates to how G20 member countries have ensured their financial regulators have '*the requisite resources and expertise to oversee the risks associated with financial innovation'* (FSF, 2008, p.40). The second component explores how 'supervisors' have ensured that companies and their employees are able to

[1] See Diaz-Rainey and Ibikunle (2012, p. 52) and http://www.financialstabilityboard.org/about/overview.htm [cited 18/9/2013]
[2] http://www.financialstabilityboard.org/activities/implementation_monitoring/index.htm [cited 18/9/2013]

understand and manage the risks associated with financial innovation. Through illuminating the degree to which the G20/FSB recommendations are changing legislation and regulatory practices and capacity, this research paper highlights differences in the implementation of the recommendation across G20 member countries, in terms of new regulatory capabilities, legislation and rules that might impact firm level risk management.

Lastly, while this work is grounded on the growing body of literature exploring the 'dark side' of financial innovation (e.g., Henderson and Pearson, 2011), the paper does not pass judgment on individual innovations or malign financial innovation more generally. It is clear that financial innovation is not *per se* the culprit in financial crisis; rather it is the unscrupulous use or unintended consequences of financial innovations which contribute to financial problems (Diaz-Rainey and Ibikunle, 2012; Van Horne, 1985). This noted, G20 governments believed that financial innovation posed serious threats to financial stability and that new firm and regulator capabilities were required to address these risks. Accordingly, it is important to determine how G20 member countries have interpreted and acted as a result of this FSB recommendation from an empirical perspective. We do so as follows: the next section reviews relevant bodies of knowledge on financial innovation and financial regulation, Section 3 outlines our research design, Section 4 reports results, while Section 5 provides concluding remarks.

2. Literature Review

This section reviews three strands of literature related to the regulatory treatment of risks arising from financial innovation. Initially, we examine the literature on financial innovation and its negative consequences. We then examine which factors could engender differential regulatory responses; firstly, by examining national institutional characteristics which could alter policy responses and secondly, by understanding how the relationship between regulators and regulated firms can shape regulatory responses.

2.1. Financial innovation and its negative consequences

Allen and Yago (2010) define financial innovation as the creation and diffusion of new financial instruments, technologies, institutions, and markets. The early literature examining this process adopted a relatively benign view of the risks arising from financial innovations, arguing that financial innovations arise to correct market inefficiencies, and that market forces effectively regulate the risk-reward balance between transacting counterparties (Frame and White, 2004; Merton, 1995; Miller, 1986; Molyneux and Shamroukh, 1996). In this world-view, financial innovations are tools applied to existing situations to facilitate the raising of capital, transfer of risk and to provide liquidity, leading to higher economic welfare. This view has persisted. For example, Hendershott et al. (2011) cite High Frequency Trading as an example of a relatively recent financial innovation that has led to the increase of liquidity and the decrease of trading frictions and market inefficiencies in financial markets.

The credit crunch of 2007-2008 and the Global Financial Crisis (GFC) has led to a more critical treatment of this issue (e.g., Allen, 2012; Gennaioli et al., 2012; Lerner and Tuffano, 2011; Shiller, 2013; Thakor, 2012). There is increased recognition that financial innovations create risks within the global financial system (Allen, 2012; Brunnermeier, 2009) and can disadvantage customers. For instance, Kim et al. (2012) examined macroeconomic and financial data for 132 countries, finding financial innovation increases the likelihood of banking crises but decreases the probability of currency crises. Distinctly, Henderson and Pearson (2011) considered financial innovation through their assessment of retail structured equity products. They find that average prices of these products are almost 8% higher compared to the implied fair value as estimated by option pricing methods, and that the mean expected return estimate is slightly below zero. This supports their hypothesis that issuing firms may deliberately introduce innovative products to exploit uninformed investors. Bergstresser (2008) also provides equivalent findings for a larger dataset of equity products from the US, Europe and Asia.

Theoretical concerns raised by financial innovation are also diverse. Fostel and Geanakoplos (2012) show that the timing of financial innovations (in particular, that of tranching and CDSs) may have contributed to the GFC. Gennaioli et al. (2012) develop a model of financial innovation where financial institutions engineered securities perceived to be safe, but which are exposed to neglected risks. This outcome arises from two key assumptions: (1) that investors neglect risks deemed to be unlikely to occur, and (2) that investors demand securities with safe cash flows. Finally, Thakor (2012) suggests that the exploitation of uninformed investors creates systemic risks when they recognize the undesirability of the investments. Because of potential noise in their ability to discriminate between desirable and undesirable investments, these investors could decide to withdraw all of their capital from financial markets, leading to a system-wide funding crisis.

Past reviews of this literature have therefore and perhaps unsurprisingly focused on the multitude of consequences arising from financial innovation. For example, Diaz-Rainey and Ibikunle (2012) report financial innovation results in adverse outcomes due to (1) predatory schemes, (2) abuse of financial innovation, and (3) unintended consequences of financial innovation. To examine this diversity of cases, it has been proposed that existing theoretical and empirical approaches should be complemented by additional and distinct methods to study these complex circumstances. In particular, case studies can illuminate the complex relationships at the nexus of risk, regulation and financial innovation (Lerner and Tuffano, 2011).

2.2. Can institutional characteristics influence regulatory responses?

In this section we explore which institutional factors interact with regulatory responses to financial innovation concerns; factors including dominant forms of firm financing, the regulatory structure, financial history, the role of the central bank and legal differences.

A first national characteristic which could influence regulatory responses is the role played by financial institutions within an economy. It has been argued that some nations including Germany (e.g., Köke, 2004) and Japan (e.g., Morck and Nakamura, 1999) employ a distinct bank-based form of capitalism. In these systems, firms are assumed to become long term clients of some banks, enabling banks to shape decisions made by firms (Franks

and Mayer, 1998) and for politically important firms to obtain preferential bank financing (Hoshi and Kashyap, 2004). This influence is derived from banks holding equity shares in firms, banks exercising voting rights of shares held in custody (Franks and Mayer, 1998) and bankers occupying chairmanship roles on firms' boards and joining supervisory boards upon retirement (Dittmann et al., 2010); all practices viewed to act against shareholders' interests.

The extent of these relationships and their implications are disputed (see Miwa and Ramseyer, 2002). Banks may have limited control over firm behaviours (Köke, 2004), and their relationships with firms may have a limited impact on economic performance (Levine, 2002). This financing system may operate to aid and promote banks' interests (Dittmann et al., 2010). This form of firm financing could create a regulatory focus on bank actions over and above other financial institutions. Alternatively, banks could lobby to limit the development of alternative non-bank sources of finance (Morck and Nakamura, 1999).

These differences in firm financing are related to the legal system and form of national law. In particular, French and German legal systems have been associated with lower levels of creditor protection, different forms of financial systems, and more common bank shareholding and financing (see La Porta et al., 1998, 1999). English legal systems, by contrast, are frequently associated with market financing of firms and greater protection for minority shareholders. Therefore, regulatory responses under different legal systems could favour certain types of financial institutions or, indeed, focus on these institutions more intensively.

The form and structure of the regulatory system could also influence the regulatory responses made by individual nations. For example, Goodhart (2000) associated greater decision making abilities with more centralised systems with fewer regulators, relative to more fragmented regulatory systems where multiple regulators coexisted. Concerns also persist that the scope of financial regulation (see Carvajal et al., 2009; Goodhart, 2008) and also the number and authority of regulators can affect the efficacy of regulatory actions.

Similarly the role of the central bank within an economy may be influential due to potential conflicts of interest. If the central bank has independent powers to set interest rates and operate monetary policy, combining this role with a regulatory function could place excessive power in the hands of unelected officials and compromise the authority of the central bank if regulation is seen to fail (see Westrup, 2012). Conversely, having the central bank serve as the supervisory agency creates information synergies with the conduct of monetary policy (Goodhart and Schoenmaker, 1995), making central banks well suited for a regulatory function. Assessing the joint influence of regulatory structure and central bank power for 68 nations, Masciandaro (2006) reports that regulatory responses to new financial challenges are likely to be dependent, to some degree, on the structure of existing regulatory bodies.

Lastly, financial history may influence regulatory responses. A country which has previously suffered substantial costs due to past financial crisis should be aware of the needs to regulate robustly and amend firm behaviours to reduce the severity and occurrence of future financial crises. Thus, financial crises could act as an exogenous shock to regulatory systems to create external pressures (political and reputational) that increase the demanded

level of regulation. Alternatively, nations without a history of financial crisis may appreciate such a position due to a history of robust regulatory actions.

2.3. How relationships between regulators and regulated firms shapes regulation

The relationships between regulators and the regulated firms may also influence regulatory outcomes. While regulators are established for the purpose of regulating industries in the interest of the public and when first set up, tend to pursue the public interest in an aggressive manner, this behaviour can evolve over time. For example, Leiserson (1946) documents forces which weaken the aggressiveness of regulatory institutions. Firstly, they lose the co-operation of the industry that they are regulating, which limits the ability to discover potential risks. Secondly, they may lose public and political support due to the concerted lobbying efforts of that industry which may eventually lead to their closure. Similarly, Bernstein (1955) observed that independent commissions begin to reflect the interest of the forms they regulate overtime. Stigler (1971) further proposed that regulators are eventually captured by regulated firms, resulting in regulators acting for the benefit of those industries rather than protecting the public interest.

The process and techniques through which regulators may be captured and influenced has focused on the incentives underlying these relationships and the processes through which firms can influence regulators. Laffont and Tirole (1991) show it is in the best interest of a regulated industry to pay (capture) the regulatory institution (the agent) so that the institution does not provide accurate information to lawmakers (the principal). This process enables lawmakers to weaken regulators' abilities to constrain an industry's capacity to generate excess rents. In a similar vein, Martimort (1999) proposes regulatory capture arises from a self-enforcing exchange of favours, between regulators and the industry that they regulate. Hence, the life-cycle of regulators is such that they start out un-captured, and are slowly captured by the industry that they regulate, until they are rendered ineffective by their capture.

A key process through which relationships between regulated firms and regulators are shaped is through lobbying: a practice important across the corporate world. The effect of lobbying in the financial industries may be demonstrated through the development of international and national regulation (see Young, 2012), by preferential lending for politically connected companies and by an increased possibility of bailout for politically connected lenders (Faccio et al., 2006). Evidence of these links is particularly strong in the USA, where the allocation of TARP bailout funds during in the 2007 financial crisis was closely associated with the level of lobbying activity by financial firms with political connections (Blau et al., 2013). In the USA, these relationships are influenced by the role of politicians on regulatory committees and particularly if a local politician is a chair person of an influential regulatory committee (Gropper et al., 2013). Reflecting these concerns, it is proposed that the different national relationships between regulators and regulated firms and the degree of lobbying may alter regulatory responses.

3. Methodology

This section reports the research design of the study. The hypotheses to be tested are provided in Section 3.1, Section 3.2 introduces the dataset, Section 3.3 outlines the approach to coding data, Section 3.4 reports the derivation of our dependent variables from the content analysis and Section 3.5 outlines the additional data employed and reviews the econometric approach adopted.

3.1. Hypotheses

As previously noted, this study considers how different G20 countries interpret and implement the FSB/FSF recommendation that:

> "*Supervisors should see that they have the requisite resources and expertise to oversee the risks associated with financial innovation and to ensure that firms they supervise have the capacity to understand and manage the risks*." (FSF, 2008, p. 40)

The significance of the research from a policy and practitioner perspective is to highlight jurisdictional differences across the G20 in terms of the scope, nature and level of implementation of these recommendations, and why responses may vary between nations. To achieve this goal we conduct content analysis on G20 countries' progress with respect to these recommendations. We therefore derive our first hypothesis:

H_1: There is a failure to treat risk from financial innovation in a thematic and comprehensive manner

Following the literature review, we identify there are institutional factors which may influence regulatory responses. Therefore, the type of legal system, the form of firm financing, financial history, the current level of financial development and the degree of regulatory concentration and central bank power are all institutional characteristics which influence regulatory responses. This leads to the second hypothesis:

H_2: Institutional factors will influence the strength of regulatory response

Lastly, the relationships between regulators and regulated firms have been seen to influence regulators outcomes and actions. We therefore propose that that degree of lobbying is influential. This results in our third hypothesis:

H_3: Countries will differ in their type of regulator response according to the links between regulator and regulated firms.

We also acknowledge the outcomes of these hypothesises may be interlinked. For example, it might be expected that a history of past financial crises is linked to a stronger regulatory response. On the other hand, the 'regulatory cycle' suggests that while new regulators may pursue the public interest robustly, lobbying and regulatory capture may ultimately weaken regulators over time (Bernstein, 1955; Martimort, 1999; Stigler, 1971), allowing for new

financial excesses to arise. This suggests that the relationship between past crises and measures implemented may not be linear and may be moderated by the strength of the financial system and economy. We also acknowledge there may be other factors which may also significantly influence these responses, no least the scale of the economy and relative level of financial development. To accommodate these concerns we also consider a measure of economic development and financial development in the analysis as a control.

3.2. G20/FSB dataset

G20 member responses were hand collected from the FSB's web site.[3] In total 73 reports from 25 member jurisdictions were downloaded, with three reports spanning the years 2010, 2011, and 2012 for each member jurisdiction, excepting India where only one report for 2012 was available. Table 1 (Panel A) provides a list of member jurisdictions covered in this dataset. In 2010 and 2011, G20 members were encouraged to follow the reporting format in Panel B of Table 1, while the format changed in 2012 (Panel C).

Of the 73 observations (also referred to as reports or report extracts) there were six blank observations (Indonesia 2010, Russia 2010-2012, Turkey 2012, The Netherlands 2010). Some countries had the same responses in consecutive years. The examples given in Table 2 for Australia and China in 2010 and 2011 show this trend. This occurs mainly in the 2010 and 2011 responses and perhaps arises from changes in reporting format as described above. The responses to 'Progress to Date' range from short responses to long, detailed responses.

3.3. Content analysis: coding and coding reliability

Content analysis is commonly used in disclosure studies (Beattie and Thomson, 2007) and was the method used to extract the data in this study. The narrative descriptions of progress on reforms related to risk from financial innovation in the 73 2010-12 FSB Report extracts were read manually and concurrently coded to allow quantitative analysis of those responses (Guthrie et al., 2004). Figure 1 displays the coding schema used. Information for Section A was easily recorded from the report extracts. However, information for Sections B-D required the coder to read the narrative for meaning and make a judgement about the evidence presented. Evidence of a response in a particular cell was coded as 1 and absence as 0. These scores could then be accumulated by section, year or G20 country as required in order to provide measures of type or strength of response for the hypotheses analysis.

Table 1: The Dataset

[3] http://www.financialstabilityboard.org/implementation_monitoring/jurisdiction.htm

Panel A: List of G20 member jurisdictions covered in this dataset

1. Argentina	10. Indonesia	19. South Africa
2. Australia	11. Italy	20. Spain
3. Brazil	12. Japan	21. Switzerland
4. Canada	13. Republic of Korea	22. Turkey
5. China	14. Mexico	23. United Kingdom
6. France	15. The Netherlands	24. United States of America
7. Germany	16. Russia	25. European Commission
8. Hong Kong SAR	17. Saudi Arabia	
9. India	18. Singapore	

Panel B: Reporting Format 2010 and 2011

1. Deadline
2. Progress to date:
    a. In addition to information on progress to date, specifying steps taken, please address the following questions:
        i. Have there been any material differences from relevant international principles, guidelines or recommendations in the steps that have been taken so far in your jurisdiction?
        ii. Have the measures implemented in your jurisdiction achieved, or are they likely to achieve, their intended results?
    b. Also, please provide links to the relevant documents that are published.
3. Planned next steps:
    a. Timeline, main steps to be taken and key mileposts (Do the planned next steps require legislation?)
    b. Are there any material differences from relevant international principles, guidelines or recommendations that are planned in the next steps?
    c. What are the key challenges that your jurisdiction faces in implementing the recommendations?

Panel C: Reporting Format 2012

1. Deadline
2. Progress to date:
    a. Implementation ongoing:
    b. Draft regulations/guidelines being developed, expected publication by:
    c. Draft regulations/guidelines published as of:
    d. Final rules expected to be in force by:
    e. Others, please specify:
    f. Completed as of:
    g. Overview (short description) of action(s) taken:
    h. Web-links to relevant documents:
3. Planned next steps:
    a. Planned actions (if any):
    b. Expected commencement date:
    c. Web-links to relevant documents:

Table 2: Sample responses

Australia, 2010 and Australia, 2011
"The budgetary resources allocated to APRA and ASIC are regularly monitored to ensure they continue to be adequate."
China, 2010 and China, 2011
"The CBRC has established a department to regulate financial innovation and made it clear that commercial banks should be well informed of their counterparties, businesses and risks, and estimate related costs. The CBRC has issued rules on conducting prudential regulation over specific businesses, to guide banking financial institutions, including the Guidance on Financial Innovation of Commercial Banks and Guidance for Supervision and Management of Asset Backed Securitisation. In accordance with the Securities Law and the Regulation on the Supervision and Administration of Securities Companies, the CSRC fulfils the responsibility of supervision and administration of securities companies. Securities companies and their domestic subsidiaries shall not be engaged in a certain business unless approved by the CSRC. In order to effectively control risks, the financial innovation of securities companies should also be supervised by the CSRC. The CIRC regulated various businesses and the use of insurance funds, encouraged innovation by market participants in line with regulatory requirements, and built up institutional arrangements to prevent relevant risks. Administrative Rules on the Appointment Qualifications of Directors and Senior Managers of Insurance Companies and the Guiding Opinions on Corporate Governance Structure of Insurance Companies specify that directors must meet qualification requirements and have the operation and management capabilities required to assume their risk positions. The Guidelines on Risk Control over Management of Insurance Funds specify that the board of directors is responsible for making major investment decisions, developing investment strategy for new investment categories, reviewing risk control system and monitoring implementation of risk control measures."

Source: FSB Implementation Monitoring Network Survey 2010 and 2011

Because content analysis requires judgement on the part of the coder, rigorous steps to ensure reliability (accuracy, stability and reproducibility) of the data were implemented (See Table 3 Panel A). These steps consisted of a research team discussion to develop a predetermined standard and accurate coding schema before coding commenced, an initial training period of the main coder (Coder 1), a coding trial, periodic recoding of several reports by the main coder to test for stability of coding over time, and recoding of several reports by a second coder (Coder 2) to test for inter-coder reproducibility of the coding (Krippendorff, 1980; Lombard et al., 2002). The coding trial, stability and reproducibility tests are described in more detail below. Krippendorff alphas, which provide a measure of the agreement between two sets of coding decisions, were calculated to ensure that stability and reproducibility met acceptable criteria. More formally, Krippendorff alphas are given by,

$$\alpha = 1 - \left(\frac{D_o}{D_e}\right) \tag{1}$$

where D_o is the observed disagreement among values assigned to units of analysis and D_e is the disagreement one would expect due to chance rather than to the properties of these units (see Krippendorff, 1980 and Krippendorff, 2011 for a more detailed derivation and discussion). An α of +0.75, or above, is considered to be a minimum acceptable standard of reliability (Milne and Adler, 1999).

Panel A of Table 3 details the series of tests undertaken during the coding of the FSB reports and Panel B reports the results of the Krippendorff alpha reliability tests. We calculated Krippendorff alphas using the algorithm outlined in Hayes and Krippendorff (2007), thereby allowing us to report bootstrap derived confidence intervals for α.

Figure 1: Coding Schema

Basic information about response (Section A)						
1. Country	2. Year	3. Response?	4. Repeat?	5. # PTD*	6. # PNS*	7. Words

Yes → No or partial

Interpretation (Section B)					
9.1 Regulatory capabilities?	9.2 Firm capabilities?	9.3 other	10.1Sectoral focus	11 # agencies	12. Agencies

Yes Yes

Response related to REGULATORY capabilities (Section C)
Implemented i.e. from "Progress to Date"
13. New Measures? (yes/no)
14.1 [R] Recruitment
14.2 [T] Training
14.3 [NO] New organisational structure
14.4 [NC] New monitoring body e.g. committee
14.5 [NR] New regulator
14.6 [NA]New Acts i.e. with legal standing
14.7 [NG] New Guidelines without legal standing
14.8 [O]Other
15. Describe other
Proposed i.e. from "Planned Next Steps"
16. New Measures? (yes/no)
17.1 [R] Recruitment
17.2 [T] Training
17.3 [NO] New organisational structure
17.4 [NC] New monitoring body e.g. committee
17.5 [NR] New regulator
17.6 [NA]New Acts i.e. with legal standing
17.7 [NG] New Guidelines
17.8[O]Other
18. Describe other

Response related to FIRM capabilities (Section D)
Implemented i.e. from "Progress to Date"
19. New Measures? (yes/no)
20.1 [R] Recruitment
20.2 [T] Training
20.3 [NO] New organisational structure
20.4 [NC] New monitoring body e.g. committee
20.5 [NR] New regulator
20.6 [NA]New Acts i.e. with legal standing
20.7 [NG] New Guidelines without legal standing
20.8 [O]Other
21. Describe other
Proposed i.e. from "Planned Next Steps"
22. New Measures? (yes/no)
23.1 [R] Recruitment
23.2 [T] Training
23.3 [NO] New organisational structure
23.4 [NC] New monitoring body e.g. committee
23.5 [NR] New regulator
23.6 [NA]New Acts i.e. with legal standing
23.7 [NG] New Guidelines
23.8 [O]Other
24. Describe other

* PTD = Progress to Date, PNS = Planned Next Steps

An initial trial of three countries' reports over three years highlighted several areas for research team discussion and subsequent extra guidance in coding and these are described in Appendix 1. After standardising the coding decision rules, the coding (at the subsection level) of these nine reports by the two coders (inter-rater reliability or reproducibility) showed acceptable agreement with $\alpha = 0.84$ (Table 4, Stage 1), and the coding for analysis by Coder 1 commenced.

During the data gathering, tests for the stability or "consistency" of content analysis coding were undertaken. These were implemented after the first 28 reports had been coded (Stage 3) and again at the end of the coding of the 73 reports (Stage 5). A test-retest procedure was used, with the six reports (2010-12) from China and Brazil being re-coded each time. Krippendorff alphas of 0.87 and 0.88 (Table 3 Panel B) indicated highly stable coding by Coder 1.

Table 3: Coding the Data

Panel A: Stages of coding the data

Stage		**Description**	**Number of reports**	
			Coder 1	**Coder 2**
1	Trial & Reliability Test 1	Code three countries over three years (Argentina, Australia and China) and initial Reproducibility Test	9	9
2	First Ten	Coding of first ten countries in alphabetical order (including trial three)	28 [a]	n/a
3	Reliability Tests 2	Stability Test (China and Brazil)	6	n/a
		Reproducibility Test (surveys for EU 2011[b] , France 2010 and Germany 2010)	n/a	3
4	Last Fifteen	Coding of last fifteen countries in alphabetical order	45	n/a
5	Reliability Tests 3	Stability Test (China and Brazil)	6	n/a
		Reproducibility Test (2010 surveys for Japan and the UK and the 2012 survey for the US[c])	n/a	3

Panel B: Krippendorff's Alpha for stability and reproducibility (inter-coder reliability)

Stability	**Alpha**	**q[d]**	**LL95%CI**	**UL95%CI**	**Observers**	**Pairs(n)**	**Bootstraps**
Total	0.910	0.000	0.8577	0.9483	3	223	1000
Stage 3	0.873	0.039	0.7823	0.9637	2	78	1000
Stage 5	0.880	0.031	0.7804	0.9601	2	73	1000
Reproducibility	**Alpha**	**q[d]**	**LL95%CI**	**UL95%CI**	**Observers**	**Pairs(n)**	**Bootstraps**
Total	0.8420	0.086	0.7827	0.8946	2	230	1000
Stage 1	0.8359	0.149	0.7538	0.9062	2	124	1000
Stage 3	0.8268	0.402	0.6824	0.9423	2	56	1000
Stage 5	0.8675	0.112	0.7349	0.9669	2	50	1000

[a] India only responded to the FSB survey in 2012

[b] 2011 for the EU was used since the 2010 EU response to the FSB financial innovation recommendation was not substantive

[c] 2012 for the US was used since the 2010 and 2011 US surveys responses to the FSB financial innovation recommendation were not substantive

[d] Probability (q) of failure to achieve an alpha of at least alpha minimum 0.8000

Table 4: Summary of Scope and Type of Planned and Implemented Measures (per country n=25)

Scope and Type of measure	Recruitment	Training	New Organisational Structure	New Monitoring Body	New regulator	New Acts	New Guidelines	Other	Total	Percent
Regulator (PTD)	8	13	5	9	0	5	4	0	44	72%
Regulator (PNS)	1	2	3	2	2	0	0	1	11	18%
Firm (PTD)	0	2	0	0	0	1	3	0	6	10%
Firm (PNS)	0	0	0	0	0	0	0	0	0	0%
Total	9	17	8	11	2	6	7	1	61	100%
Percent	15%	28%	13%	18%	3%	10%	11%	2%	100%	

Key: PTD (Progress to Date), PNS (Planned Next Steps)

Table 5. Nature of response, interpretation and measures by country [a]

	Basic information (Section A)			Interpretation (Section B)									Measures (Sections C & D)		
Country	**Responses**	**Original**	**Words**	**Reg.**	**Firm**	**Banking**	**Markets**	**Personal**	**Insurance**	**Systemic**	**Commod.**	**Total**	**Reg.**	**Firm**	**Total**
Argentina	3	2	243	1	0	1	1	1	1	1	0	5	6	0	6
Australia	3	1.5	146	1	0	0	1	0	0	0	0	1	3	0	3
Brazil	3	2	412	1	1	1	1	0	0	1	0	3	6	0	6
Canada	3	2	425	1	0	1	1	1	0	1	0	4	3	0	3
China	3	1.5	369	1	1	1	1	0	1	0	0	3	6	3	9
EU	3	3	104	1	0	1	1	0	1	1	0	4	3	0	3
France	3	2	235	1	1	1	1	1	1	0	1	5	5	0	5
Germany	3	1	107	1	1	1	1	0	1	1	0	4	2	0	2
Hong Kong	3	2	485	1	1	1	1	0	1	1	0	4	3	0	3
India	1	1	262	1	1	0	1	1	0	0	0	2	1	0	1
Indonesia	2	1.5	283	1	1	1	0	0	0	1	0	2	1	0	1
Italy	3	2	338	1	1	1	1	1	1	1	0	5	3	1	4
Japan	3	1	187	1	1	1	1	0	1	1	0	4	1	0	1
Korea	3	1.5	51	1	0	1	1	1	0	1	0	4	2	0	2
Mexico	3	1	64	1	0	0	1	0	0	0	0	1	1	0	1
Netherlands	2	1.5	62	1	1	0	0	0	0	1	0	1	0	0	0
Saudi Arabia	3	1	100	1	1	1	1	0	1	1	0	4	1	1	2
Singapore	3	1	261	1	1	1	1	1	1	1	0	5	0	0	0
South Africa	3	1.5	287	1	1	1	1	0	1	1	0	4	3	0	3
Spain	3	1.5	195	1	0	1	0	0	1	1	0	3	0	0	0
Switzerland	3	1.5	132	1	0	1	1	0	1	0	0	3	1	0	1
Turkey	2	1	23	0	0	0	0	0	0	0	0	0	0	0	0
UK	3	2.5	426	1	0	1	1	1	1	1	0	5	4	0	4
United States	1	1	114	1	1	1	0	0	0	0	0	1	0	1	1
Average	2.60	1.50	212.44	0.92	0.56	0.76	0.76	0.32	0.56	0.64	0.04	3.08	2.20	0.24	2.44
SD	0.82	0.61	140.05	0.28	0.51	0.44	0.44	0.48	0.51	0.49	0.20	1.63	2.00	0.66	2.27
Maximum	3.00	3.00	485.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.00	6.00	3.00	9.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[a] Russia did not respond to the recommendation in any of the three years; [b] this is a subjective strength of response given by Coder 1.

To test for reproducibility, a 'test-test' procedure was used. *"The aim of reproducibility is to measure the extent to which coding is the same when multiple coders are involved"* (Weber, 1988, cited in Milne and Adler, 1999, p. 239). Three other reports which had been previously coded by Coder 1 were also coded by Coder 2 at Stages 3 and 5 (Table 3 Panel A) and the Krippendorff alphas of 0.83 and 0.87 (Table 3 Panel B) indicate a high level of agreement between coders. Both the stability and reproducibility tests provide confidence that the data collected is highly reliable.

Table 4 and Table 5 provide descriptive results of the coding. For instance, from Table 4 we learn that five jurisdictions implemented New Acts, while eight countries have recruited staff with the relevant expertise and one country is planning to increase 'Recruitment' (PNS: Planned Next Steps). From Table 4 we can see that Hong Kong *Responded* in all three years, two of those three responses were *Original* (were not simple repetitions of prior years)[4] containing 485 original *Words.* The interpretation (*Section B*) of the recommendation was purely focussed on regulatory capabilities (*Reg.* = 1 and *Firm* = 0), which is reflected in the measures implemented or planned (*Section C and Section D* respectively) with 6 measures that enhanced regulatory capabilities and no measures focused on firms. Further, Hong Kong's disclosure suggested they interpreted the recommendation in quite broad sectoral terms with their responses alluding to *Banking*, *Capital Markets*, *Insurance* and *Systemic* risks.

3.4. Index of disclosed strength of response

Following the completion of the content analysis we developed a strength of response index[5], S_i, for each country's disclosure using the following formula,

$$S_i = \frac{2w_A}{\pi} \cdot \arctan\left(\frac{o_i c_i}{\tilde{c}}\right) + \frac{w_B k_i}{12} \cdot (g_i + m_i) + \frac{2}{\pi} \cdot \left[w_R \cdot \arctan\left(\frac{r_i}{\bar{r}}\right) + w_I \cdot \arctan\left(\frac{f_i}{\bar{f}}\right)\right] \qquad (2)$$

where:

w_x refers to the weights given to each component (A, B, R, and I corresponding to Sections A, B, C and D in Figure 1 and Table 6 respectively) of the index;

o_i is a bounded variable $[0, 3]$ that proxies for the originality (*Original*) of responses for country i over the survey period (*Section A*);

[4] A .5 score represents partial repetition in one year. For example, in the case of Australia there was one original response and a second response which partially repeated the first, leading to an originality score of 1.5.
[5] Appendix 2 provides a discussion of the mathematical form of the index.

c_i is an unbounded variable $[0, \infty]$ that measures the total word count (*Words*) for country i over the survey period (*Section A*);

g_i and m_i are dummy variables that take on the value 1 if country i's response addresses regulatory-level and firm-level issues, respectively, and 0 otherwise (*Section B*);

k_i is a bounded variable $[0, 6]$ indicates, out of the six sectoral categories, the number of categories that country i's response addresses (*Section B*);

r_i is an unbounded variable $[0, \infty]$ that counts the number of new regulatory-level measures that country i has implemented (*Section C*);

f_i is an unbounded variable $[0, \infty]$ that counts the number of new firm-level measures that country i has implemented (*Section D*).

$\tilde{c}$, $\bar{r}$, and $\bar{f}$ are the median of c_i, average of r_i, and average of f_i for all countries i.

Thus, our disclosure index can be split into four components mirroring our coding: A, B, R, and I. Firstly, component A is a summary of some basic metrics for information content such as word count and originality (*Section A*). Next, component B measures the range of interpretations for each country under our classification system (*Section B*). Finally, components R and I assign a score to the implementation of new measures, on the regulatory-level and firm-level respectively (*Section C* and *Section D* respectively).

We assigned weights of 10%, 40%, 25%, and 25% to components A, B, R, and I respectively which resulted in an index for each country as outlined in Table 6. The table suggests that based on self-disclosures (or absences thereof), Italy, China and France have had the strongest responses to the recommendation. As part of the coding, the main coder (Coder 1) provided a *Subjective* score out of 10 for the strength of response. From Table 6 it is clear there is a strong congruence between the *Objective* and *Subjective* measure, though clearly the former is preferable.

By deriving an objective Index of Disclosed Strength of Response (S_i), we therefore have a dependent variable with which to explore our hypotheses. This provides a comprehensive measure of disclosed strength of response. We also derive a second dependent variable as the count of all implemented measures (i.e. the sum of r_i and f_i, We call this variable $MTOTAL_i$) which provides an alternative, more implementation focused measure of strength of response.

Table 6: Index of Disclosed Strength of Response (S_i)

Country	Responses	Subjective	Objective	A: 10%	B: 40%	R: 25%	I: 25%
Italy	3	4	0.633	0.082	0.333	0.149	0.068
China	3	8	0.622	0.078	0.200	0.194	0.149
France	3	5	0.592	0.075	0.333	0.184	0.000
Hong Kong	3	5	0.503	0.087	0.267	0.149	0.000
South Africa	3	4	0.489	0.073	0.267	0.149	0.000
Brazil	3	3	0.479	0.085	0.200	0.194	0.000
Argentina	3	4	0.436	0.076	0.167	0.194	0.000
Saudi Arabia	3	3	0.433	0.030	0.267	0.068	0.068
UK	3	5	0.425	0.088	0.167	0.170	0.000
Germany	3	3	0.416	0.032	0.267	0.117	0.000
Singapore	3	3	0.392	0.059	0.333	0.000	0.000
Japan	3	2	0.383	0.049	0.267	0.068	0.000
Canada	3	4	0.368	0.086	0.133	0.149	0.000
EU	3	1	0.347	0.064	0.133	0.149	0.000
Korea	3	1	0.275	0.024	0.133	0.117	0.000
Indonesia	2	2	0.274	0.073	0.133	0.068	0.000
India	1	2	0.261	0.059	0.133	0.068	0.000
Australia	3	2	0.236	0.054	0.033	0.149	0.000
Switzerland	3	2	0.218	0.050	0.100	0.068	0.000
United States	1	1	0.168	0.034	0.067	0.000	0.068
Spain	3	2	0.163	0.063	0.100	0.000	0.000
Mexico	3	1	0.121	0.020	0.033	0.068	0.000
Netherlands	2	1	0.095	0.028	0.067	0.000	0.000
Turkey	2	0	0.007	0.007	0.000	0.000	0.000
Russia	0	0	0.000	0.000	0.000	0.000	0.000
Average	2.6	2.72	0.333	0.055	0.165	0.099	0.014
SD	0.816	1.860	0.179	0.026	0.104	0.071	0.036
Maximum	3	8	0.633	0.088	0.333	0.194	0.149
Minimum	0	0	0	0	0	0	0

3.5. Econometric models and additional data

In addition to regulatory responses we also use another nine variables to record differences in institutional characteristics and relationships between the regulators and regulated (See Table 7). Two variables are used to indicate the legal system (ENG and FRE). Following La Porta et al. (1999), we indicate if nations have employed the English or French type of legal system. The classification of bank or market forms of firm financing used are also drawn from La Porta et al. (1999) and are represented by a dummy variable (BANK). We draw on past analysis from Laeven and Valencia (2008, 2012) to examine financial history. Specifically we examine the years since the last systematic crisis to the end of 2012, for each nation since 1970 (TIMES).

Table 7: Variables and Additional Data

Variable function	Variable	Description	Hypothesis	Source	Obs	Mean	Std. Dev.	Min	Max
Dependent Variables	S	index of disclosed strength of response	Dependent	CA	25	0.33	0.18	0.00	0.63
	MTOTAL	count of total measure implemented	Dependent	CA	25	2.44	2.27	0.00	9.00
Effect of past crises	TIMES	Years since last systematic crisis (to end of 2012)	H2	LV	18	10.72	5.97	5.00	20.00
Legal Origin	ENG	Dummy =1 if English origin to legal system	H2	LP	24	0.33	0.48	0.00	1.00
	FRE	Dummy =1 if French origin to legal system	H2	LP	24	0.38	0.49	0.00	1.00
Type of system	BANK	Dummy =1 if 'bank-based' and =0 if 'market-based' [b]	H2	DKL	22	0.41	0.50	0.00	1.00
Regulatory structure	CBCON	Central Bank power scale 1 to 3, with a higher score representing greater Central Bank influence on financial regulation	H2	M	20	1.80	0.83	1.00	3.00
	CONCE	Degree of regulatory concentration on a scale of 0 to 7, with a higher score representing greater concentration	H2	M	20	3.10	2.57	0.00	7.00
Regulator/ regulated relationship	LOBBY	Constructed index (see Equation 4) for importance of financial sector relative to GDP	H3	WB1	24	271.09	135.36	86.79	609.60
Economic development	LNGDP	Log GDP per capita (2010 current US$)	Control	WB2	25	9.89	1.01	7.26	11.16
	DEV	Dummy =1 if financially developed and =0 if finically underdeveloped [b]	Control	DKL	22	0.68	0.48	0.00	1.00

Key: CA – author derived from the content analysis see Section 3.4; LV - Laeven and Valencia (2012); LP - Based on La Porta et al. (1998;1999); M - Masciandaro (2006); DKL - Demirgüç-Kunt and Levine (1999) for all counties except for China where the source was Allen et al. (2005); WB1 – World Bank Database on Financial Development and Structure (November 2013); WB2 – World Bank Database on Development Indicators (accessed 1/7/2014)

Notes: [a] includes all types of crises (Systemic banking, currency and sovereign debt); [b] There was no data for Russia, Saudi Arabia or the European Union.

The classification of regulatory systems draws from Masciandaro (2006) and is undertaken in two parts. Initially, the number of financial regulators is recorded to determine the degree of regulatory concentration (CONCE). This index has a maximum score in nations where all the financial supervision responsibilities are undertaken by a single agency, such as the United Kingdom or Germany. Conversely, the index has a lower score in nations where more agencies have responsibility for financial regulation and supervision such as within the US or France. The second measure considers the role of the central bank in financial regulation and supervision (CBCON). To measure the central bank's involvement in financial supervision, we adopt Masciandaro's measure where a greater value is assigned when the central bank is the only body responsible for banking supervision.

To consider relationships between regulators and regulated firms, the variable LOBBY is calculated from the World Bank Database on Financial Development and Structure. From this database, we initially sought to add the ratios of central bank assets to GDP, deposit money bank assets to GDP, and other financial institutions' assets to GDP, since, as noted by Beck et al. (2000, p. 600), the "*sum of the three measures equals the total claims that financial intermediaries have on nonfinancial domestic sectors, relative to GDP.*" However, the data for the third ratio was missing for twelve of the twenty-four (the EU excluded) G20 jurisdictions. In order to reflect the importance of 'other financial' institutions we constructed the following index,

$$\begin{aligned} \text{LOBBY}_i = {} & CENTRAL\ BANK\ ASSETS\ to\ GDP\ (\%) \\ & + DEPOSIT\ MONEY\ BANK\ ASSETS\ to\ GDP\ (\%) \\ & + STOCK\ MARKET\ CAPITALIZATION\ to\ GDP\ (\%) \\ & + PRIVATE\ BOND\ MARKET\ CAPITALIZATION\ to\ GDP\ (\%) \\ & + PUBLIC\ BOND\ MARKET\ CAPITALIZATION\ to\ GDP\ (\%) \end{aligned} \tag{3}$$

We use the first two ratios suggested by Beck et al. (2000) and then proxy for the importance of 'other financial institutions' through measures of equity and bond markets to GDP. We used eleven year averages for each component variable, covering 2001 to 2011. Lastly, the two control variables representing the level of financial development and GDP are derived from the World Bank Database on Financial Development and Structure (2013) and the World Bank Database on Development Indicators (2014).

We examine the three hypotheses (see Section 3.1) using descriptive and empirical approaches. Hypothesis 1 is considered through assessment of the coded survey responses. Hypotheses 2 and 3 are then assessed empirically using the index of disclosed strength of regulatory response (S_i) and the count of total regulatory measure(s) implemented ($MTOTAL_i$). The bounded nature of S_i (bounded between 0 and 1) implies that a fractional response model is more appropriate to determine the impact of the explanatory variables on S_i. We therefore assume a nonlinear conditional mean model for S_i,

$$E(S_i|\boldsymbol{x}) = G(\beta_0 + \beta_1 \text{TIMES}_i + \beta_2 \text{ENG}_i + \beta_3 FRE + \beta_4 \text{BANK}_i + \beta_5 \text{DEV}_i + \beta_6 \text{CBCON}_i + \beta_7 \text{CONCE}_i + \beta_8 \text{LOBBY}_i + \beta_9 LNGNP_i) \quad (4)$$

where $\boldsymbol{x}$ is the vector of the explanatory variables and $G(\cdot)$ is any cumulative density function satisfying $0 \leq G(\cdot) \leq 1$. This guarantees that the predicted values of S_i are restricted to the unit interval (Ramalho and Ramalho, 2011). We estimate five commonly used fractional response models: Cauchit, logit, probit, log-log, and complementary log-log (cloglog). These models differ only in terms of the cumulative distribution function they assume.[6] The results are presented in Table 8.

Our second dependent variable is the count of all implemented measures (i.e. $MTOTAL_i = r_i + f_i$). Consequently, we use a Poisson regression model and specify the conditional mean of $MTOTAL_i$ as the exponential function:[7]

$$E(MTOTAL_i|\boldsymbol{x}) = e^{(\alpha_0 + \alpha_1 \text{TIMES}_i + \alpha_2 \text{ENG}_i + \alpha_3 FRE + \alpha_4 \text{BANK}_i + \alpha_5 \text{DEV}_i + \alpha_6 \text{CBCON}_i + \alpha_7 \text{CONCE}_i + \alpha_8 \text{LOBBY}_i + \alpha_9 LNGNP_i)} \quad (5)$$

We use the maximum likelihood method to estimate Equation (5) and present the results in Table 8.

4. Results and Discussion

The results are reported in order of the hypotheses considered, and are reported in Tables 4, 5 and 6 for Hypothesis 1 and in Tables 8 and 9 for Hypotheses 2 and 3.

4.1 Descriptive results and hypothesis 1

When addressing Hypothesis 1, we observe in Tables 4, 5 and 6 how jurisdictions have responded to the proposal, which areas of financial market activity have been the focus of attention in the survey responses and how strongly they have responded. From these tables we observe there is a dispersion of responses and a variety of areas of interest identified. Specifically, from Table 4, it is reported that across the twenty-five G20 jurisdictions, a total of 61 measures were planned or implemented as a result of the recommendation. Most of the measures reported by countries were already implemented (82%) with only eleven (18%) being indicated as "planned next steps". This suggests very little forward planning to tackle the recommendation. Further, most planned or implemented measures (additional/new recruitment,

[6] See Ramalho and Ramalho (2011) for details about these models.
[7] It is not appropriate to ignore the special nature (i.e. count variable) of the dependent variable and apply standard linear regression models. See Winkelmann (2008) for more on this.

training, guidelines) were easier to implement relative to more challenging measures (new laws/acts, regulators, committees). The three most common types of measures implemented or planned were training (28%), a new monitoring body (e.g. Committee) (18%) and recruitment (15%).

At a disaggregate country level, Table 5 provides *basic information* about the nature of the responses, the *interpretation* of the recommendation and the *measures* implemented or planned. For instance, Germany responded in all three years but provided the same response (original=1) throughout, whereas the EU provided a different response each year (original=3). Large interpretative differences of the recommendation also appear across nations. For instance, Table 5 reports whether the response is regulatory in focus, or considers amendments to how financial firms should or must operate. It is reported that 92% of states have interpreted the recommendation in terms of regulatory capabilities, with only 52% emphasizing firm capabilities as well. This suggests that numerous states have had a limited *interpretation* of the scope of the recommendation. This bias towards regulatory capabilities relative to firm capabilities is even more accentuated when looking at the average number of *measures* implemented or planned: 2.2 for regulatory capabilities, but only 0.24 for firm capabilities. This equates to 90% of all measures planned or implemented relating to regulatory capabilities with only the remaining 10% relating to firm capabilities (See Table 4).

Table 5 also records the markets or sub-sector *interpretation* of the recommendation by different jurisdictions (Banking, Capital Markets, Personal Finance, Insurance, Systemic or Commodities). While no country or jurisdiction interpreted the recommendation in terms of all six sub-sectors, Argentina, France, Italy, Singapore and the UK have adopted broad interpretations mentioning five sub-sectors. Most countries interpreted the recommendation in terms of Banking (76%) and Capital Markets (76%) with only 32% and 4% focussing on Personal Finance and on Commodities, respectively. Again, it can be concluded that large interpretive differences are evident, with some markets considered more than others.

When considering the objective index of disclosed *strength* of regulatory response, the average response score (0.333 from a maximum of 1) is low (See table 6 and Section 3.4). The strongest response was attributed to Italy (0.633), followed by China (0.622), France (0.592) and Hong Kong (0.503). It is clear that some jurisdictions have been more proactive in implementing measures than others, with China implementing the most measures (n=9) and The Netherlands and Singapore having zero implemented measures (See Table 5).

When addressing Hypothesis 1, we conclude there is a failure to treat risks from financial innovation in a thematic and comprehensive manner in most but not all nations. Most of the emphasis has been on strengthening regulatory capabilities, while efforts to build firm capabilities have been limited. Clearly, there is a diversity of responses in the survey, representing large interpretative differences and variance in the strength of regulatory responses.

4.2 Econometric results and hypotheses 2 and 3

The results of fractional response and Poisson models are reported in Table 8. We estimated five fractional response models and carried out a series of hypothesis tests for the statistical validity of them using the methodology in Ramalho and Ramalho (2011). We first implemented RESET-type tests to test the hypothesis $E(S_i|\boldsymbol{x}) = G(\beta\boldsymbol{x})$ against the hypothesis that quadratic and cubic terms in the fitted $\beta\boldsymbol{x}$ values are included in $G(\cdot)$. The null hypothesis was rejected for only the log-log model. Therefore, we dropped the log-log model and focused on the remaining four models. We next implemented goodness-of-link tests for testing the functional form of $G(\cdot)$ for the particular fractional response model. We then implemented two goodness-of-functional-form tests as suggested by Ramalho et al. (2014). All four models were found to be admissible. Facing four admissible non-nested competing models, we then applied a series of p-tests where we tested each model against each other competing model. We were not able to reject any of the four models against an alternative model in any pairwise comparison when we used the robust Lagrange multiplier version of the p-test. However, we rejected the logit and probit models against the Cauchit model when we used the robust *t* version of the test. There is clearly no dominating model (although the Cauchit and cloglog models are never rejected against a competing model), so results from all these four models are reported in Table 8. There is perhaps a case to be made for the Cauchit model based on its higher R^2-type measure that indicates a better fit.

We used the quasi-maximum-likelihood (QML) approach to estimate the Poisson model as preliminary tests revealed that the data were not Poisson distributed. The estimation procedure gives robust standard errors which also take care of the violation of the equidispersion assumption, although overdispersion was not found to be a problem with our data.[8] Results are reported on Table 8 together with the results of the fractional response models.

Inspection of the results in Table 8 reveals that all the models produce the same conclusion in terms of the sign of the regression coefficients in each model. There are, however, differences in terms of the statistical significance of coefficient estimates. The importance of the impact of a dependant variable in a nonlinear model is best determined by considering the marginal effects of them, because the coefficient estimates only give the direction of the impact with the magnitude of the impact depending on the values and coefficients of all the dependant variables. We therefore calculated these marginal effects for each of the dependant variables for each country in our sample, and averaged them across the countries. These average marginal effects are presented in Table 9. In general, the choice of model matters most when it comes to these partial effects. It is striking that the different fractional models are found to produce very similar marginal effects, particularly when they are statistically significant.

[8] See Cameron and Trivedi (2010) for details about these issues in Poisson estimation.

Table 8: Regression results

Dependent Variable	Index of disclosed strength of response (S_i)				$MTOTAL_i$
VARIABLES	(1) logit	(2) cauchit	(3) probit	(4) cloglog	(5) Poisson
TIMES	0.044	0.172	0.0198	0.0515	0.085
	(0.071)	(0.142)	(0.038)	(0.068)	(0.119)
ENG	1.047	**2.898***	0.534	1.090	2.042
	(0.787)	(1.685)	(0.373)	(0.750)	(1.365)
FRE	-1.224	-0.337	**-0.801***	-0.793	-0.618
	(0.791)	(0.561)	(0.461)	(0.546)	(0.807)
BANK	**1.260*****	**2.143****	**0.727*****	**1.107*****	1.228
	(0.383)	(1.045)	(0.196)	(0.380)	(0.754)
CBCON	**1.549*****	**1.779*****	**0.920*****	**1.261*****	**1.455*****
	(0.300)	(492)	(0.163)	(0.251)	(0.392)
CONCE	**0.357*****	**0.442*****	**0.211*****	**0.294*****	**0.342****
	(0.089)	(0.136)	(0.052)	(0.076)	(0.118)
LOBBY	-0.006	-0.012	**-0.004***	-0.006	-0.011
	(0004)	(0.008)	(0.002)	(0.004)	(0.007)
LNGDP	**1.282*****	**2.080****	**0.746*****	**1.102****	**1.913****
	(0.477)	(1.013)	(0.262)	(0.450)	(0.860)
DEV	-1.466	-0.647	**-0.956***	-1.040	-1.695
	(0.940)	(2.100)	(0.492)	(0.867)	(1.730)
CONSTANT	**-15.67*****	**-26.15****	**-9.006*****	**-14.11*****	**-19.817****
	(5.238)	(12.093)	(2.628)	(5.146)	(9.734)
Observations	15	15	15	15	15
R^2-type measure	0.74	0.85	0.73	0.76	0.30
AIC	2.10	2.09	2.10	2.10	
BIC	-12.86	-12.96	-12.86	-12.86	

All reported (in parentheses) standard errors are robust standard errors. *** Significance at %1 level, ** at 5% and * at 10%

Regulatory concentration (CONCE), central bank concentration or power (CBCON) and the level of economic development as proxied by the log of GDP (LNGDP) are statistically significant in all models. These relationships are highly significant for both dependant variables (at the 1% level) and at the 1% and 5% level for economic development (LNGDP). These results indicate that the strength of regulatory response to the proposals on tackling risks arising from financial innovation and the number of implemented measures to achieve this goal are positively related to the degree to which regulators are concentrated (situations where fewer regulators exist) and the relative power or level of responsibility held by the central bank. Further, the size of the economy is also associated with stronger regulatory responses and more policy measures being implemented.

The average marginal effect of Central Bank power (CBCON) is statistically significant with an estimated value of 0.30 (or 0.32 if the Cauchit model is used). That is, all else remaining the same at the observed values, the mean value of the change in the index of disclosed strength of response is 0.30 if each country's Central Bank power scale increases by 1. This is quite significant since the observed mean value of S_i is 0.33 in our sample. The average of the increase in the count of total measures implemented is estimated to be 3.30 for the same increase in CBCON, which is more than double of the observed mean. In comparison, the impact of regularity concentration (CONCE) is only 0.07 on S_i, and 0.78 on MTOTAL.

Table 9: Average Marginal Effects

Dependent Variable	Index of disclosed strength of response (S_i)				$MTOTAL_i$
VARIABLES	(1) logit	(2) cauchit	(3) probit	(4) cloglog	(5) Poisson
TIMES	0.008	0.032	0.006	0.012	0.192
	(0.013)	(0.025)	(0.011)	(0.435)	(0.266)
ENG	0.201	**0.380*** **	0.172	0.277	12.86
	(0.139)	(0.0083)	(0.116)	(0.170)	(19.023)
FRE	**-0.217***	-0.060	**-0.237****	-0.186	-1.624
	(0.125)	(0.097)	(0120)	(0.124)	(2.530)
BANK	**0.239*** **	**0.317*** **	**0.232*** **	**0.259*** **	3.310
	(0.061)	(0.068)	(0.057)	(0.073)	(2.642)
CBCON	**0.295*** **	**0.329*** **	**0.292*** **	**0.302*** **	**3.297*** **
	(0.048)	(0.063)	(0.0046)	(0.050)	(0.819)
CONCE	**0.068*** **	**0.082*** **	**0.067*** **	**0.070*** **	**0.775*** **
	(0.015)	(0.019)	(0.015)	(0.016)	(0.250)
LOBBY	**-0.001***	-0.002	**-0.001***	-0.001	-0.026
	(0.0007)	(0.001)	(0.0006)	(00009)	(0.016)
LNGDP	**0.244*** **	**0.385****	**0.236*** **	**0.263*** **	**4.337****
	(0.083)	(0.160)	(0.077)	(0.099)	(1.896)
DEV	**-0.269***	-0.115	**-0.290****	-0.257	-6.690
	(0.156)	(0.346)	(0.130)	(0.211)	(12.726)

The reported values are the average values of the marginal effects calculated for all observations using the observed values for the covariates. The marginal effects for dummy variables are calculated as discrete changes from their base levels. Standard errors are calculated by the Delta method using the robust standard errors of coefficient estimates, and are reported in parentheses. *** Significance at %1 level, ** at 5% and * at 10%.

The variable representing whether a nation is characterised by a bank-based form of firm financing or otherwise (BANK) is also reported to be significant at 1% in all models where the index of disclosed strength of regulatory response (S_i) is the dependent variable. The average impact on the index of

disclosed strength of response of being a bank-based country as opposed to being a market-based country is estimated to be between 0.23 and 0.32 depending on the model used. This relationship is not significant when the count of total implemented measures ($MTOTAL_i$) is the dependent variable. This indicates that if a nation has a bank-based system of firm financing, regulatory responses to the proposals on tackling risks arising from financial innovation are stronger. This result appears plausible as the GFC was primarily a banking and systemic crisis. The strength of the response is not significantly associated with the number of implemented policy measures. Despite this recorded insignificance, the Poisson model records that the BANK coefficient was in the same direction as other models and was close to being marginally significant with p=10.4%.

Both variables representing different types of legal system (ENG) and (FRE) have significant results in the Cauchit and probit fractional models respectively at the 10% level. This indicates there is limited evidence that the type of legal system and the strength of regulatory responses can be linked. The variable representing lobbying (LOBBY) was marginally significant in just one model (at the 10% level). This relationship is negative as might be expected (a strong financial sector relative to GDP is associated with a weaker response). It is, however, only marginal and its average effect is very small (Table 9). This noted, the effect of LOBBY is likely to have been weakened by the inclusion of the control variable DEV because, as is apparent from Table 8 and Table 9, the two variables are capturing related influences.

Lastly, one variable, the financial history of a nation (TIMES), is observed not to be significant in any model. This suggests that the relationship between the strength of the regulatory response or the number of implemented policy measures and financial history either does not matter, or this relationship is non-linear and is not observed by empirical method.

We therefore conclude, when addressing Hypothesis 2, that the form of regulatory structure and central bank power are strong positive influences over regulatory responses. Further, the form of financing also has an association with the level of regulatory response, with bank-based systems more likely to have a strong response. The legal system appears to have a limited influence on regulatory responses.

When considering Hypothesis 3, there is marginal evidence that the level of lobbying reduces the regulatory response. Overall, we can conclude relationships with regulatory response with the level of lobbying is significant, yet are far less influential than other institutional factors. Lastly, two control variables, representing economic and financial development, have a positive and negative relationship with regulatory responses respectively. The influence of economic development is seen to have a far stronger influence on regulatory responses.

5. Conclusion

In this study we examined both how nations have responded to proposals to tackle the risks posed by financial innovation and analyzed which factors influence the strength and extent of this regulatory response. This examination is undertaken through assessment of a key recommendation of the Financial Stability Board (FSB) at the 2009 G20 meeting in London to mitigate risks from financial innovation.

Overall, our results indicate that G20 states have found it difficult to interpret and address the FSB recommendation related to financial innovation in a comprehensive and thematic manner. We believe this has ultimately led to the recommendation being given a low priority. This is an issue of major concern if, as many agree, financial innovation played an important role in the GFC. It would seem that G20 states need guidance on how to interpret (thematically) and how best to tackle this recommendation. This should come from an assessment of best practice in this area, both in term of measures implemented since the GFC and in terms of measures that buffered countries ex ante from the effect of the GFC. Our coding of the responses of G20 states to the FSB recommendation should assist in the process of exploring best practice in this area.

Further, we determined which institutional factors drove regulatory responses. We found that the concentration of regulatory structure and the strength of the central bank have particularly strong positive influences on the level and extent of regulatory responses. Other institutional factors are also reported to be influential, albeit at much lower levels of consistency across implemented models and significance levels. These are the form of firm financing (bank-based financial systems were associated with stronger responses) and type of legal system. The financial history of a nation is not observed to be a significant factor in influencing regulatory responses.

It is also reported that the relationship between regulators and regulated firm embodied by a measure of lobbying activity is seen to be related with the level of regulatory response, yet only marginally so in one of the reported models. Lastly, two control variables representing economic and financial development also influence these regulatory responses.

We see these results as important in the context of the literature addressing the response to the Global Financial Crisis (GFC). It is widely acknowledged that the GFC had differential real economic impacts on countries, in terms of real output and demand (Claessens et al., 2010; Giannone et al., 2011; Lane and Milesi-Ferretti, 2010; Rose and Spiegel, 2011). Much of this literature attempts to explain differences in the impact of the GFC through the examination of pre-crisis conditions and their interaction with global economic factors. Developing this work, another set of literature has focussed its attention on the steps that policymakers and regulators can take in order to reform current financial systems. For example, Claessens et al. (2010) highlight the importance of strengthening the international financial architecture in the areas of surveillance, information sharing, crisis management, and liquidity support. They also call for national regulators to reform domestic financial architectures to monitor common predictors of crises,

such as asset price bubbles, rapid expansion of credit, and the appearance of marginal loans that depend on unsustainably favourable macroeconomic conditions.

Acknowledging the importance and astuteness of these recommendations, it is important to determine whether such thinking, often derived from academics and communicated and interpreted through policy forums, results in altered regulatory actions in practice. It is clear these responses, in the specific context of mitigating the risks from financial innovation, are limited across the G20 nations. Further, these responses are conditioned by regulatory structure and other institutional factors.

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Appendices

Appendix 1: Coding Decision Rules for Subsections

1. **Coding 9.1 and 9.2**

   Yes (Presence = 1) = Must materially or substantively address the issue of financial innovation.

   E.g. Australia, 2012 - key phrases such as "*keeps pace with industry*" and "*relevant market experience*" when discussing training and recruitment i.e. thereby addressing the dynamic nature of financial innovation.

   No (Absence = 0) = Does not materially or substantively address the issue of financial innovation.

   e.g. Australia, 2010 and 2011 – general responses such as "*The budgetary resources allocated to APRA and ASIC are regularly monitored to ensure they continue to be adequate*".
2. **Coding 10.1 to 10.6**

   If there is new text in a subsequent year and a substantive response (i.e. 9.1 or 9.2 are coded 1) then code, then new references to particular sectors should be coded as 1 but not as a count if there are multiple references)
3. **Consistency issue for null cases for 13, 16, 19 and 22**.

   Only complete 13 and 16 if there is a 1 in 9.1.

Only complete 19 and 22 if there is a 1 in 9.2.

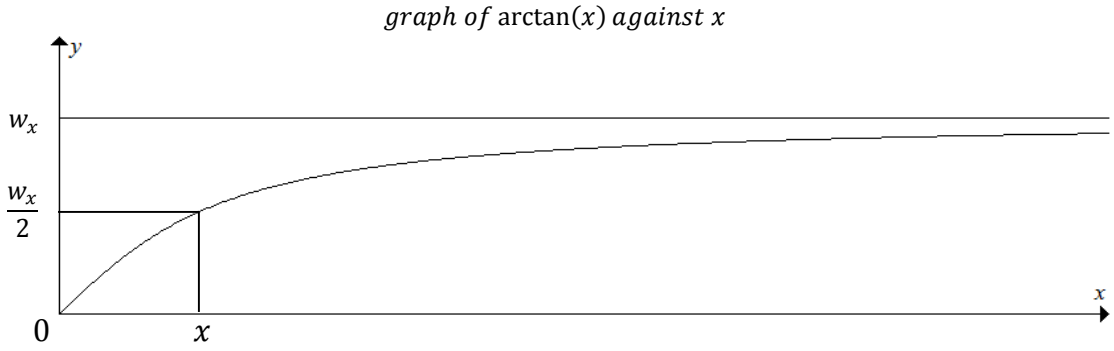
Appendix 2: Mathematical form of index

Our choice of the arctangent function in calculating components A, R, and I is motivated by the following considerations:

1. **Asymptotic maximum**. Because the variables c, r, and f are unbounded, they need to be mapped to a function with a asymptotic maximum in order to produce sensible values for higher values.
2. **Marginal contribution tends to zero**. This is a natural consequence of consideration 1, but we believe that this is an important point that bears note. As the variables c, r, and f increase unboundedly, their marginal contribution towards the final disclosure score should tend towards zero; i.e. there are decreasing marginal returns to extra disclosure and additional implementation of new measures. Our choice of function, thus, reflects the need for the first derivative to tend to zero as the underlying variable increases:

$$\lim_{x\to\infty} \frac{f'(x)}{dx} = 0$$

With these considerations in mind, we chose the arctangent function, domain $[0, \infty]$, which created a mapping with range $\left[0, \frac{\pi}{2}\right]$ to transform the c, r, and f scores. Scaling the range of the function to the desired weights was achieved by multiplying by $\left[\frac{2}{\pi}\right]$. Finally, $\tilde{c}$, $\bar{r}$, and $\bar{f}$ are used as scaling factors to horizontally scale the function such that $\arctan(x) = \frac{w_x}{2}, x = \tilde{c}, \bar{r}, \bar{f}$.



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